CHAPTER 1. PART 21

FAR 21 - GENERAL

CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS
(Amendment 21-50)

AC 21.16. § 21.16 SPECIAL CONDITIONS.

a. The Process. Chapter 2, Section 1, Paragraph 8 of the Type Certificate Handbook, Order 8110.4A, provides detailed guidance on the special conditions process. However, much of that material has been outdated with the implementation of the Aircraft Certification Directorate Program. Rotorcraft special conditions are processed through the Rotorcraft Standards Staff, ASW-110. That office will assure coordination with the affected agency and industry elements including the Assistant Chief Counsel. All comments will be considered and the disposition will be documented by the Rotorcraft Standards Staff. ASW-100 will issue the special conditions.

b. Basis for Development.

(1) Special conditions are justified on the basis of the existing Part 29 being inadequate or inappropriate due to novel or unusual design features of the rotorcraft to be certificated.

(2) The phrase “novel or unusual” as used in § 21.16 is a very relative term. As used hereafter in applying § 21.16 to justify the issuance of special conditions, “novel or unusual” will be taken with respect to the state of technology envisaged by the applicable airworthiness standards of this subchapter. It must be recognized that in some areas which will vary from time to time, the state of the regulations may somewhat lag the state of the art in new design because of the rapidity in which the state of the art is advancing in civil aeronautical design and because of the time required to develop the experience base needed by the FAA/AUTHORITY to proceed with general rulemaking. Applicants for type certification of a new design have the opportunity to mitigate the impact of not knowing the precise airworthiness standards to be applied for “novel or unusual design features” by consulting with the FAA/AUTHORITY early in their certification planning when such features are suspected or known by the applicant to exist. It should also be recognized that, because of the intentional objective nature of the airworthiness standards of this subchapter, many new design features which might be thought of as “novel or unusual” may already be adequately covered by existing regulations, thus obviating the need to issue special conditions.

(3) Before proposing special conditions, the certification staff should very thoroughly analyze the existing regulations and assure they are inadequate or inappropriate in light of a new and novel design feature.

AC 21.31 § 21.31 TYPE DESIGN. The regulatory basis for requiring data to define the design is contained in § 21.31. This section is self-explanatory and broad enough in scope to give the certification staff access to sufficient data to determine compliance with Part 29.

AC 21.33 § 21.33 INSPECTION AND TESTS.

a. Applicant Responsibility. Section 21.33 requires the applicant to:

(1) Assure the test rotorcraft conforms to the type design. This must be accomplished prior to presentation to the FAA/AUTHORITY for testing.

(2) Conduct all inspections and tests necessary to determine compliance with the airworthiness and noise requirements.

b. FAA/AUTHORITY Responsibility.

(1) The design evaluation engineers should assure that the type design is adequate in their technical area and that the inspections and tests to be conducted are appropriate and sufficient to show compliance with Part 29.

(2) As changes to the rotorcraft are made during the test program, the flight test crew should assure that the appropriate design evaluation engineer concurs with the change and the conformity inspection of the change has been conducted.

AC 21.35 § 21.35 (Amendment 21-59) FLIGHT TESTS.

a. Explanation.

(1) This section outlines the requirements of the applicant for aircraft type certification and should be used in conjunction with FAA Order 8110.4A, Section 5. Section 21.35 requires, in part, that the applicant conduct sufficient flight tests to show compliance with the flight requirements throughout the proposed flight envelope. The results of the applicant's flight test should be submitted to the FAA/AUTHORITY in report form for evaluation to determine what verification flight tests the FAA/AUTHORITY may elect to conduct. The report should conclude that in the applicant's opinion the test aircraft complies with the applicable certification requirements. The FAA/AUTHORITY verification flight test should include, but not be limited to, the critical or marginal results contained in the applicant's flight test report. The FAA/AUTHORITY's role in the certification effort is not envisioned to be one of conducting day-to-day routine flight tests with the applicant, but only to verify his results through limited sampling. In certain tests, such as high altitude testing at a remote mountain site, there is an advantage in conducting flight tests concurrently with the applicant. Additionally, the FAA/AUTHORITY can provide technical flight test

assistance to the applicant in certain cases. This can be done after a cursory review and a letter of authorization is issued to the flight test crew.

(2) Preflight Test Planning. After the applicant's flight test report is reviewed, it should be determined what FAA/AUTHORITY engineering flight tests are necessary. These tests are normally specified in the Type Inspection Authorization (TIA). At the same time the FAA/AUTHORITY must know and agree to the applicant's proposed means of data acquisition, reduction, and expansion of the flight test data. The adequacy of the test instrumentation should be evaluated prior to official type certification tests (reference paragraph AC 21.39).

(3) Order of Testing. The Federal Aviation Regulations are so worded that the results of some flight tests have a definite bearing on the conduct of other tests. For this reason, and to minimize retesting, careful attention should be given to the order of testing. The exact order of testing will be determined only by considering the particular rotorcraft and test program involved. Tests which are particularly important in the early stages of the program are:

(i) Airspeed calibration: All tests involving airspeed depend upon the calibration.

(ii) Engine power available determination.

(iii) Engine cooling.

(4) Test Groupings.

(i) Weight and c.g.: In addition to the regulatory relationship of one test to another, efficient testing requires that consideration be given to the accomplishment of as many tests on a single flight as can be accommodated successfully.

(ii) Special Instrumentation. Similarly, consideration should be given to grouping of tests that involve special instrumentation. Examples of these are takeoff and landing tests which usually require group equipment to record horizontal distance, height, and time. Ground calibration of the airspeed indicating system can be accomplished at the same time. It is the applicant's responsibility to provide the necessary instrumentation.

(5) Functional and Reliability Testing

(i) Section 21.35(b)(2) requires that the applicant determine that "there is reasonable assurance that the aircraft, its components, and its equipment are reliable and function properly." Section 21.35(f)(1) requires a Function and Reliability (F&R) program of 300 hours for turbine engine powered aircraft incorporating engines of a type not previously used in a type certificated aircraft. Section 21.35(f)(2) requires a 150-hour F&R program for all other aircraft. The following reflects general practices

that have been used during rotorcraft certification programs. FAA/AUTHORITY have supported proposals which gave F&R test time credit for certification testing in lieu of dedicated F&R testing. In establishing such credit, the following should be considered:

(A) The point in time in which the rotorcraft reaches substantial conformity with the approved type design.

(B) The extent and complexity of the new design.

(C) For a previously certified rotorcraft, the F&R program requirement should be commensurate with the modification or change in type design and may be zero.

(ii) Historically, for major rotorcraft type certification programs, flight time credit has been limited so as to require an irreducible minimum of 50 hours of dedicated F&R flight time. For rotorcraft programs that involved new engine installations (mature engine design) or drive train/rotor system changes on previously certified aircraft (TC amendments or STC's), flight time credit has been liberal and often resulted in very little or no dedicated F&R testing.

b. Procedures.

(1) Type Certification Flight Tests.

(i) Prior to initiating official FAA/AUTHORITY flight tests, a conformity inspection of the test aircraft must be accomplished. This is needed to assure that the test aircraft is in the proper configuration or "conforms" to the engineering drawings and documents that have been submitted to FAA/AUTHORITY, evaluated, and approved. It is absolutely essential to know the configuration being tested in any engineering flight evaluation. Conformity inspection prior to TIA flight tests assures that testing will not be wasted because of configuration uncertainties.

(ii) FAA Order 8110.4A, paragraph 67, contains a requirement that the applicant must keep the FAA/AUTHORITY advised of any configuration changes to the aircraft. The manufacturing inspector should keep the FAA/AUTHORITY flight test pilot apprised of any change which may affect safety of the test aircraft or may influence test results.

(iii) Results of the conformity inspection and the engineering flight test program must be documented. This is normally done in the Type Inspection Report (TIR). Results may be documented in any acceptable engineering format. The report should be in sufficient detail to clearly show how compliance with each appropriate section of the rules was determined.

(iv) The flight test pilot must assure that the FAA/AUTHORITY manufacturing inspector and certification engineer are aware of all configuration

changes found necessary as a result of FAA/AUTHORITY tests. The manufacturing inspector is responsible for assuring that all changes are incorporated into production drawings after the design data reflecting the change have been approved by the certification engineer.

(v) Additional flight test responsibilities, procedures, and requirements during the certification flight test process are contained in FAA Order 8110.4A, Section 5, Flight.

(2) Function and Reliability Tests.

(i) A comprehensive and systematic check of all aircraft components must be made to assure that they perform their intended function and are reliable.

(ii) F&R testing should be accomplished on an aircraft which conforms to the type design. Non-conformities must be documented and accepted. F&R testing should follow the type certification testing described in paragraph AC 21.35b(1) above to assure that significant changes resulting from type certification tests are incorporated on the aircraft prior to F&R tests.

(iii) All components of the rotorcraft should be periodically operated in sequences and combinations likely to occur in service. Ground inspections should be made at appropriate intervals to identify potential failure conditions; however, no special maintenance beyond that described in the aircraft maintenance manual should be allowed.

(iv) A complete record of defects and failures should be maintained along with required servicing of aircraft fluid levels. Results of this record should be consistent with inspection and servicing information provided in the aircraft maintenance manual.

(v) A certain portion of the F&R test program may focus on systems, operating conditions, or environments found particularly marginal during type certification tests.

(vi) A substantial portion of the flying should be on a single aircraft. The flying should be carried out to an intensive schedule on an aircraft that is very close to the final certification standard, operated and maintained as though it were in service. A range of representative ambient operating conditions and sites should be considered. It is acceptable for non-F&R flight testing conducted at various sites and in varying ambient conditions to be used to satisfy the F&R requirements for those conditions.

AC 21.39. § 21.39 (Amendment 21-59) FLIGHT TEST INSTRUMENT CALIBRATION AND CORRECTION REPORT.

a. Explanation. It is the applicant's responsibility to provide instrumentation for all parameters needed to show compliance with the airworthiness regulations.

(1) For those data which are necessary to show compliance with the regulations, a permanent record should be established. A permanent record is acceptable in either graphical or photographic form, and in some instances, a manual recording may be satisfactory.

(2) Regardless of the record form, the accuracy of the record must be established by reference to a laboratory standard traceable to the National Bureau of Standards.

(3) If multiplexing is used, the time base must be synchronized to a reference point from which the magnitude of each parameter can unquestionably be determined. Also, the sampling rate should be sufficiently frequent to assure that the maximums, minimums, and trends of magnitude of the parameter are recorded with respect to time.

b. Procedures. Prior to conducting flight tests, the FAA/AUTHORITY flight test team should review the applicant's flight test instrumentation calibration and correction report.

(1) Normally the frequency of instrument calibration should not exceed 90 days. However, the frequency of recalibration varies with the consistency of the instrumentation under consideration. For example, cyclic and collective position is sometimes calibrated immediately before and after a flight where these parameters are used to provide critical flight data. Six months is a typical interval for recording/signal conditioning and nonstrain gage sensors, while one year is typical for strain gauged components. Also, environmental effects such as vibration, humidity, temperature, etc., should be considered when determining whether recalibration is necessary.

(2) The highest and lowest magnitude of the parameter being recorded should be considered when establishing the scale for instrumentation. Ideally, the highest magnitude throughout the flight would fall on the maximum indicating point of the recording.